

INTERESTING WESTERN ODONATA.

By CLARENCE HAMILTON KENNEDY,
Stanford University, California.

In the following notes I wish to give a short account of the habits of some of the more interesting species of western Odonata. These are based on field observations made by the writer in Washington, Oregon, California and Nevada during the summers of 1913 and 1914.

Apparently because of the actual scarcity of streams in the west, various species of Odonata in their attempts to utilize all available water have taken on unusual habits or have developed more ordinary habits in some special direction to such a degree that they have almost assumed the grotesque in their exaggeration. One of these which might be said to have exaggerated habits is *Archilestes californica*. This species, known heretofore from the type and a single other specimen, is abundant in the Yakima Valley, Wash., and throughout Central California. It is a giant Lestes, differing from the numerous species of that cosmopolitan genus in greater size and minor venational characters.

The species of Lestes oviposit endophytically and frequently a foot or even two feet above the surface of the water, usually placing the eggs in such tender tissues as the stems of sedges and Juncus, or occasionally in tender willow shoots. In oviposition *Archilestes* follows the habits of its Lestes relatives, but because of its greater size and strength it oviposits normally from five to eight feet above the water and in the bark of willow stems that are from a half an inch to an inch and a half in diameter. Because of the size of some of the bushes used, it can almost be said to be a dragon fly that lays its eggs in trees. Oviposition is a tedious process. The male holds the female by attaching the claspers on the end of his abdomen to the posterior edge of her prothorax. Then with her abdomen bent in a loop she forces her ovipositor slowly thru the bark and deposits her eggs in clutches of six in the cambium, where they remain dormant until the following spring. The hatching has not been observed, altho it is probable that the larvae wriggle from the bark and fall into the water below. The circle of bark, under

which lies each clutch of eggs, dies after the eggs have hatched and this produces a scar, which from year to year increases laterally with the growth of the stem. Sometimes the scars of contiguous ovipositions run together and girdle a willow, so this dragonfly may be classed technically among those insects injurious to timber.

The nymphs of this dragonfly, which are probably among the largest of the Zygopterus nymphs, are peculiar in being very free swimming. On the Yakima River I worked for an hour with a rake without catching a single specimen, tho I knew from their emergence that they must be abundant. Later in California I was astonished to discover that certain "schools of minnows" were the agile nymphs of *Archilestes* fleeing enmasse from the dragonfly collector. On closer observation they were found to spend most of their time resting quietly on submerged objects, but on the approach of danger they fled precipitously to deeper water. Swimming was accomplished by a vigorous undulatory motion, in which the large caudal gills seemed of great assistance.

One of the peculiarities of the western Odonate fauna is the small number of *Argias*. This is a genus of 60 or more species the greater number of which are found in the American tropics. Eight or more occur in the eastern states, but only two are found west of the Rockies, excepting, of course, the various southern species limited to the Mexican border. Tho essentially a tropical genus, one of the two western species, *Argia emma*, is common as far north as central Washington, and the other *Argia vivida*, is found even as far north as Canada. The extraordinary northern distribution of *Argia vivida*, which occurs also as far south as southern Mexico, seems explained by its peculiar habits. All the species of *Argia* as far as is known, live in very fresh water, the majority of them being stream species. Such is *Argia emma*, which is found in the majority of the warm perennial streams of the west. But *Argia vivida* has a special preference for springs and the boggy streamlets flowing from them. This species is frequently collected on larger streams and ponds, but in such cases, when traced to its origin, is found to be emerging from some nearby spring. Now springs do not freeze, as their waters, originating deep in the ground, maintain a fairly uniform temperature

thruout the year, so that the springs in western Canada, in which *Argia vivida* has been taken are probably the warmest waters in that region, comparing not unfavorably in warmth with springs of California and even Mexico. Thus by inhabiting springs this little subtropical *Argia* easily maintains itself far beyond the usual limits of members of its genus. Its vertical distribution is equally as great as it occurs from sea level up to 6,000 feet, where it is found in springs on the shores of Lakes Tahoe and Donner.

An interesting observation in this connection is that *Argia emma*, the warm stream species, occurs also at this altitude, being found in the Truckee River at the outlet of Lake Tahoe. This is explained by the fact that the Truckee River, tho a mountain torrent and at an elevation of 6,000 feet is really a warm stream, because its supply comes from Lake Tahoe, which never freezes over. The great depths of this lake are filled during the summer with a body of water of 39° or more in temperature. (Actual measurements in August show 40° or more except in extreme depths). Tho the surface chills during the cold season, the lake waters are constantly turned over by the winter winds, bringing the warmer waters to the surface, where they keep the Truckee River supplied thruout the cold months with water several degrees above freezing.

Another Agrionine with unusual habits is *Enallagma clausum*. This is an inhabitant of the desert and seemingly enjoys its life in the alkaline ponds of this barren region. It is found in the intermountain country from the Columbia Valley to Nevada. Several species of this large genus are stagnant water species and some of these in the West live in ponds with a slight alkaline content, but *clausum* goes beyond them all and breeds in water strongly saline, for it is found breeding in large numbers in the shallow edges of Pyramid Lake, Nevada. This is one of those salt lakes in the midst of the Nevada desert which have been left by the gradual drying up of Lake Lehontin. While the alkalinity of Pyramid Lake water is but about one tenth of that of sea water, it is very near the maximum that can be endured by various brackish water species. Sea water has a density of 1.026. Osburn (Am. Nat. June, 1906), has shown that various species of odonate nymphs found commonly in brackish coast ponds can endure a density of not more than

1.003. Pyramid Lake water has a density of 1.00347 to 1.00349. The broad sandy beach at the southern end of Pyramid Lake fairly swarms with the nervous imagoes of this species, and the females accompanied by the males oviposit in the masses of filamentous algae that float in the shallow edge of the water.

Oddly enough *Enallagma clausum* shares its occupancy of Pyramid Lake with another dragon fly, a libelluline, *Sympetrum corruptum*, which just opposite to *Enallagma clausum*, instead of being a species restricted by special habits, is extremely adaptable, in fact the dragonfly, which in the west, is found in a greater variety of environments than any other. *Sympetrum corruptum* occurs from the sea level to altitudes of 3,500 feet in Washington and 5,000 feet in California, and flourishes not only in all kinds of ponds, but in all streams except those very swift mountain torrents inhabited by *Octogomphus* and *Cordulegaster*. Thus it is interesting that the extreme environmental condition found in the salinity of Pyramid Lake has been mastered as it were thru opposite types of development; by extreme specialization in *clausum* for a life in alkaline water, and by an extreme generalization in *Sympetrum corruptum* for a life in the greatest variety of waters. Both species flourish side by side and no other species was observed.

Many interesting phases of odonate habits and distribution in the West are related in various ways to the very rugged topography of this region. In a half day one can go by train from sea level in the Sacramento Valley, with its Mexican fauna and sprinkling of tropical species, to an elevation of 6,000 feet in the Sierras, where all odonate species are such as are found in Canada. These northern species are in various ways adapted to endure the cold, which prevents the occupation of these high altitudes by multitudes of dragonflies that flourish in the sunshine of the warm valleys. A special adaption, which permits one of these species to exist on this cold upper limit of odonate life was discovered while collecting about the McKinney Lakes, which lie on the divide west of Lake Tahoe, at an elevation of 7,000 feet. The species in question is the large blue *Aeshna interrupta nevadensis*. This is restricted to the summits of the Sierras having been found from an elevation of 4,000 feet at Emigrant Gap to 7,000 feet on the McKin-

ney Lakes. Five other species of *Aeshna* are found in California. These are scattered from the sea level up to 5,000 feet altitude, but *nevadensis* is the only form which flourishes at the extreme upper limit of 7,000 feet. The adaption, which permits this one species to occupy territory so far beyond the range of the genus in general, is a change in the time of emergence. As far as is known the species of *Aeshna* emerge in the nighttime, an adaption to preserve them from the birds, but *nevadensis* emerges in the day time. At this high altitude there are few species of birds that inhabit the shores of the lakes, so night emergence is not necessary. Day emergence, however, is a necessity as the nightly temperature at this altitude is very near freezing, if not actually at times below. It is interesting to note here that night emergence in *Aeshna* is a highly specialized habit, as most Odonata emerge in the day time, and that *nevadensis* belongs to one of the more generalized or primitive groups of the genus. Perhaps it has merely retained the primitive manner of emergence.

For two western species an interesting form of migration was observed. These are *Cordulegaster dorsalis* and *Octogomphus specularis*. The coast mountains of California and the western slope of the Sierras contain many perennial torrents, which do not rise high enough to contain snow water, yet occur in such steep gulches that they are a succession of rushing rapids and roaring cascades. These are inhabited by but three species of dragonflies, *Cordulegaster*, *Octogomphus* and an undescribed species of *Aeshna*. The nymphs of this *Aeshna* are agile, active creatures entirely able to stem the swift currents of these torrents, but the nymphs of *Cordulegaster* and *Octogomphus* are slow and clumsy. Moreover they do not live in the tree roots as do the *Aeshna* nymphs, but in the case of *Cordulegaster*, crawl over the bottom in the quieter parts of the pools, and, in the case of *Octogomphus*, burrow thru the organic trash in the deeper holes. Being, as it were, loose in the stream these two, during their three-year life, are washed farther and farther down stream by each succeeding freshet, so that when they come to emerge they may find themselves several miles below the point at which they hatched. This washing down is compensated by a migration upstream of the imagoes. On Stevens Creek, south of Stanford Uni-

versity, where these were most fully observed, exuviae were found in abundance two miles below the lowest point on the creek at which any imagoes were seen, and imagoes were common on the divide at the head of the creek, where few exuviae were found. These observations were checked in other parts of California. It is this migration upstream which keeps Cordulegaster and Octogomphus limited in their distribution to the head waters of these torrents and prevents their even occasional appearance in the lower level reaches of these same streams.

Cordulegaster is one of those strange insects with unusual structure and equally unusual habits, and as it lives on the headwaters of the wildest mountain streams, but little has been known concerning it. The ovipositor of the female is very long and heavy, trough-shaped affair and very blunt. After many conjectures as to how it was used, Dr. Ris finally succeeded in observing the female of a Swiss species in the act of ovipositing. This for a dragonfly was a very unusual operation. Most Zygoptera oviposit by inserting eggs in vegetable tissues with the aid of their needle-like ovipositors. Most Anisoptera oviposit by washing the eggs into the water from the tip of the abdomen. Cordulegaster does neither. The female observed flew hastily up the creek examining each sandy shallow, until she finally found one protected on three sides by stones in the water, and not over an inch deep. She hovered over this and dropping her long abdomen into a vertical position made a series of dips or backward plunges, at each dip thrusting the tip of the abdomen with its heavy blunt ovipositor thru the shallow water into the sand beneath. After perhaps a half dozen thrusts she flew up the creek a short distance and finding another shallow to her liking repeated the process. The whole process rather closely resembled the manner of oviposition of some of the crane flies.

In the canyon back of Mt. Lowe at Pasadena, Cal., I had an opportunity of observing the habits of the tropical *Pallthemis lineatipes*. This is a large red-bodied libelluline with habits of flight, which in part resemble those of a corduline and in part the high flying habits of a Tramea or Pantala. The nymphs are as interesting as the adults and were very abundant in the clear mountain stream. This flows thru a gorge whose

rocks are a coarse granite, which readily disintegrates into a very coarse sand, that is creamy white with numerous dark brown and black grains. The bed of the stream, where shallow, is composed of this coarse sand, giving it a peppered or even checkered appearance. In the deeper and swifter channels this sand is displaced by gravel and rocks. The nymphs of *Paltothermis* apparently go thru from two to three years of nymphal life before emerging. For the first two years the young nymphs crawl about over the coarse spotted sand of the shallows, but in the last year they live altogether in the deeper water. During the early stages while the young are living on the spotted grit bottom they have a very striking black and white checkered coloration, which lets them blend wonderfully well into their background of checkered sand; but in the later stages when they are on an ordinary bottom in the deeper channels they have the usual olive brown of most large odonate nymphs.

CORRECTION.

(*Athysanus villicus* Crumb =) *Deltocephalus colonus* Uhler

Too late to recall the description, I learn that my *Athysanus villicus* is a synonym of *Deltocephalus colonus* Uhler. This species was described from the island of St. Vincent.

S. E. CRUMB.